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(54) Servovalves

(57) A servovalve comprising a spool 13 which is slidable within a normal range within a bore 12 in the valve body 11 in response to differential fluid pressure acting on the ends of the spool, means 25 to bias the spool to one end of the bore and electro-mechanical control means to control the position of the spool in the body and thereby provide a variable fluid output which is proportional to the electical signal supplied to the control means, wherein in the event of a failure of supply of fluid pressure, the spool is urged by the bias means to a predetermined failure position beyond the normal range of the spool.

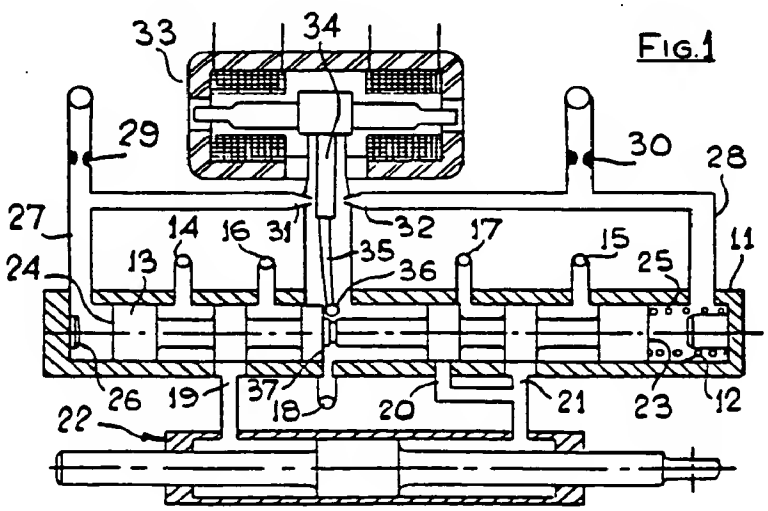

FIG.1

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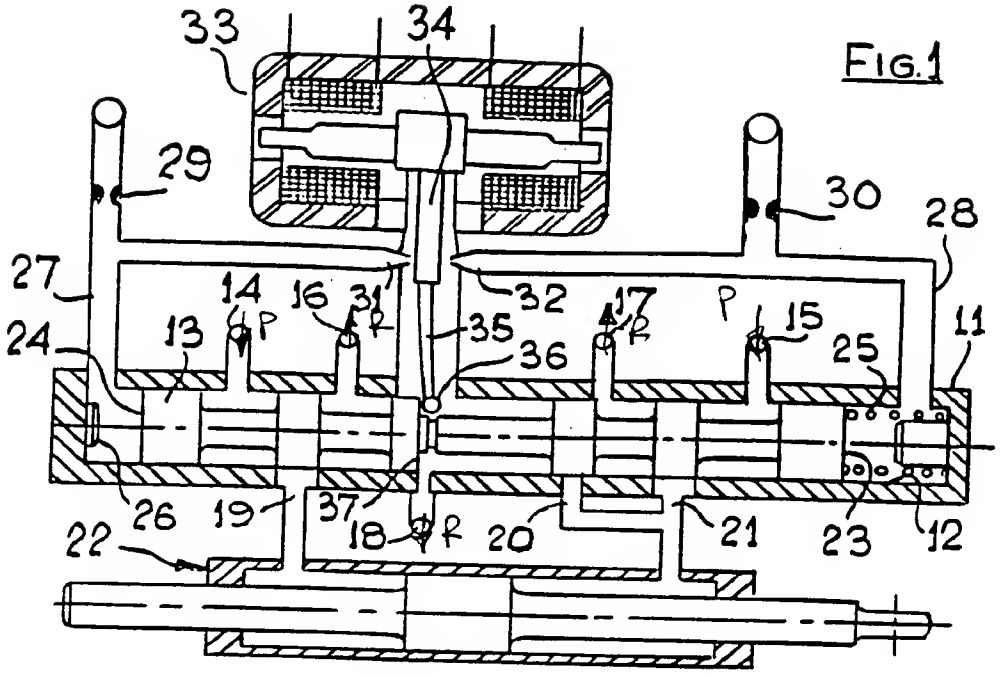

FIG.1

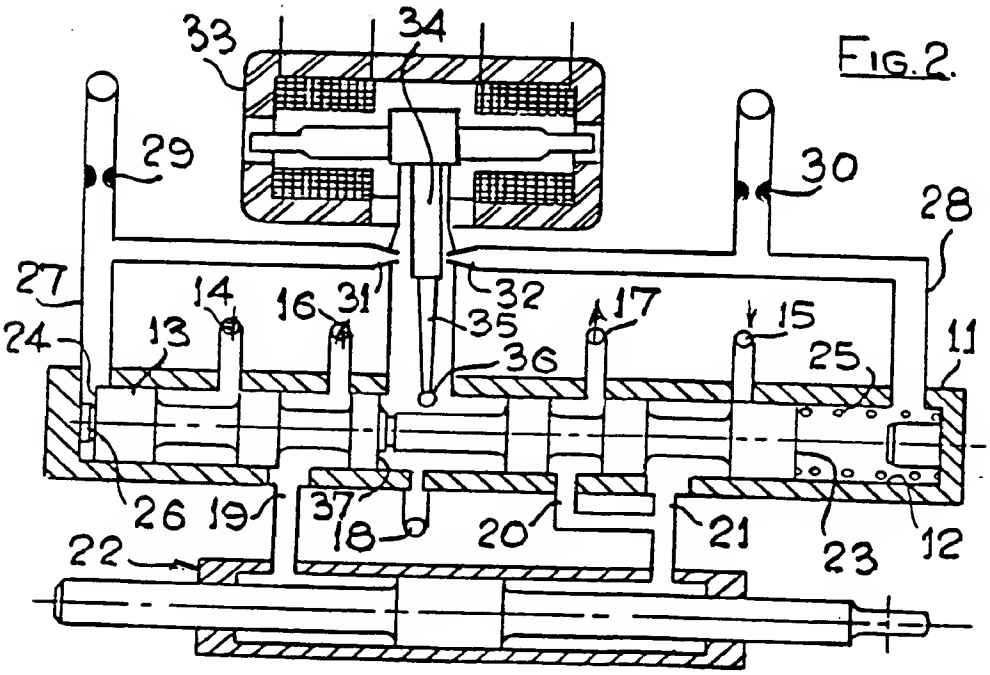

FIG.2.

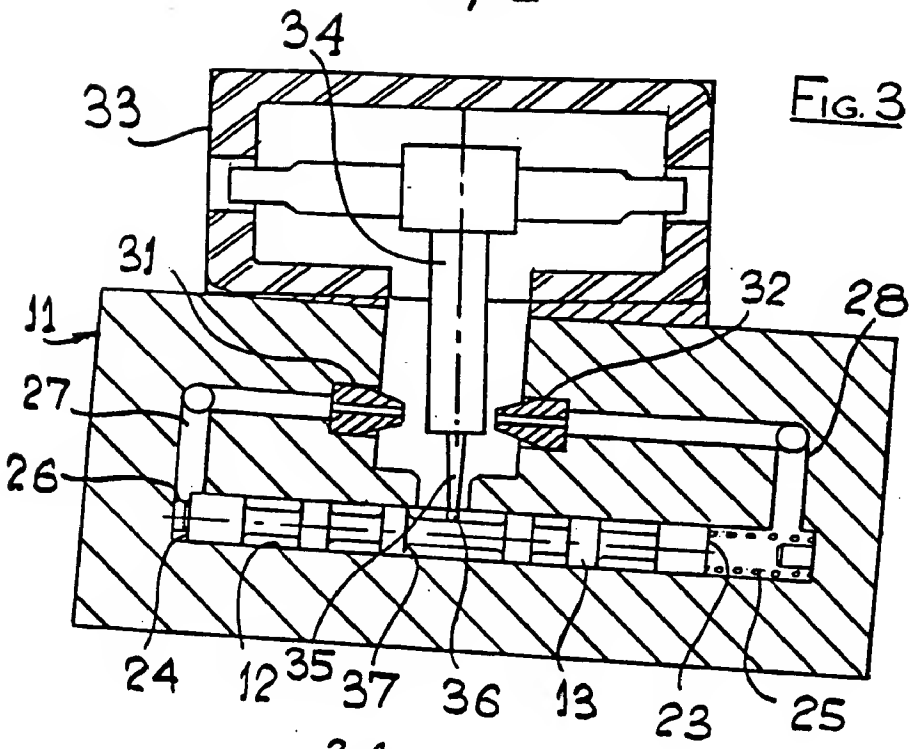

FIG. 3

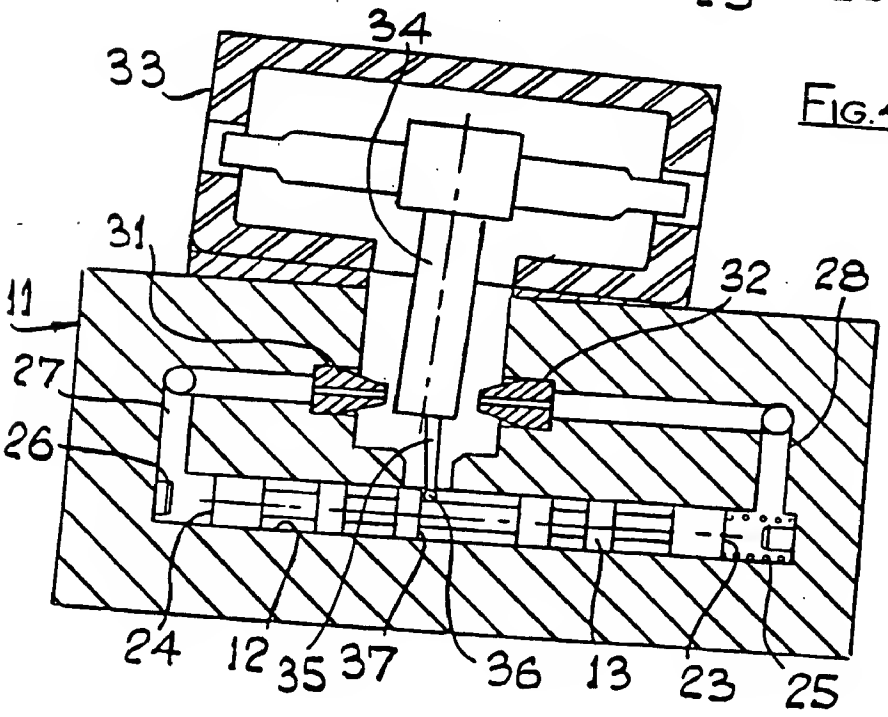

FIG. 4

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SPECIFICATION

Servovalves

This invention relates to servovalves and in particular those of the type known as flapper-nozzle servovalves.

Servovalves are known which comprise a valve body having a bore therein, at least one supply port to connect the bore to a source of pressurised fluid, at least one output port to connect the bore to pressure responsive actuator means, a spool having two distal end faces and being axially movable within the bore in response to differential fluid pressure acting on the distal end faces of the spool and electro-mechanical means to control the position of the spool within a normal range within the bore to provide a variable fluid output from the servovalve which is proportional to the electrical signal supplied to the electro-mechanical control means.

It is a disadvantage of such servovalves that, in the event of a fluid pressure failure, secondary means, for example a solenoid valve, are required to provide an immediate response to such a failure and provide for the pressure responsive actuator means to be disabled in a safe manner. The present invention is concemed with servovalves which are biassed so that, in the event of such failure, a secondary means, for example by-pass, can be performed by the valve itself.

In accordance with the invention, there is provided a servovalve comprising a body having a bore therein, at least one supply port for connecting the bore to a source of pressurised fluid, at least one output port for connecting the bore to a pressure responsive actuator means, a spool having two distal end faces and being axially movable within the bore in response to differential fluid pressure acting on the two distal end faces of the spool from the source of pressurised fluid, means to bias the spool towards one end of the bore and electro-mechanical control means to control the position of the spool within a normal range within the bore to provide a variable fluid output from the servovalve that is proportional to the electrical signal supplied to the electro-mechanical control means, wherein, in the event of a failue of supply of fluid pressure from the source, the spool is urged rapidly by the bias means to a predetermined failure position beyond the normal range of the spool.

The electro-mechanical control means is preferably a servo-motor driving a flapper for cooperation with one or other of a pair of nozzles. The flapper may also have attached thereto a resilient feedback member to engage a flange on the spool and thereby relay information regarding the spool position within the bore back to the control means.

Preferably the feedback member, conveniently with a part-spherical end, may be biassed against or within a spool flange when the spool is in the normal range. However, the engagement between the flapper and the spool must be such, for example a single flange on the spool, that the spool can be moved beyond its normal range.

The bias means may be either a spring acting, for example, on a distal end face of the spool or alternatively a mechancial offset of a servo-motor/flapper arrangement with regard to the longitudinal axis of the bore.

In the latter case in particular, the flapper may be physically offset towards one of the nozzles at least when there is no electrical signal supplied to the servo-motor.

The flapper may be physically offset in the direction to cause the spool to be moved by fluid pressure in the same direction as that in which it is urged by spring means in which case an electrical bias signal must be supplied to the servo-motor to move the flapper and thereby restore the spool to a position within the normal range of movement.

Alternatively, the flapper may be physically offset in the direction to cause the spool to be moved by fluid pressure against the action of the spring means in which case no electrical bias signal is required to bring the spool to a position within the normal range of movement.

To exemplify the invention, reference is now made to the accompanying drawings in which:

Figure 1 is a schematic cross-section through a servovalve of the invention,

Figure 2 is a schematic cross-section similar to Fig. 1 but showing a spool in a position beyond its normal range,

Figure 3 is a simplified schematic cross-section through a further servovalve of the invention, and

Figure 4 is a simplified schematic cross-section through another servovalve of the invention.

With reference to Figs. 1 and 2, the servovalve has a valve body 11 defining a bore 12 therein and a spool 13 slidable in the bore 12. The valve body 11 has a pair of inlet ports 14, 15 to connect the bore 12 in use to a source of pressurised fluid (not shown), three ports 16, 17, 18 to allow fluid to return to a reservoir (not shown) associated with the source of pressurised fluid and three supply ports 19, 20, 21 to connect the bore 12 in use to a pressure responsive actuator means 22.

The spool 13 has a pair of distal end faces 23, 24 against one of which a compression spring 25 acts to bias the spool 13 towards one end of the bore 12. The travel of the spool 13 in the bore 12 is limited by stop means 26 against which the other end face 24 of the spool 13 will abut.

The position of the spool 13 in the bore 12 is varied by altering the relative fluid pressures

supplied to the two distal end faces 23, 24. The fluid pressure is supplied from source of fluid at pressure to each of the end faces 23, 24 through respective control ports 27, 28, each of which has a restrictor 29, 30 fitted in it to reduce the flow of fluid and is connected to a nozzle 31, 32 forming part of an electro-mechanical control means.

The electro-mechanical control means further comprises an electric servo-motor 33, a flapper 34 for cooperation with the nozzles 31, 32 and a resilient feedback member 35 having a part-spherical end 36 for cooperetion with one face of a flange 37 on the spool 13.

If desired, the servo-motor 33 can be tilted relative to the longitudinal axis of the bore 12 in the manner shown in Fig. 3 thereby bringing the flapper 34 closer to the nozzle 32 than to the nozzle 31 when no electrical signal is supplied to the servo-motor 33.

In using the servovalve, when no electrical power or fluid pressure is supplied the spool 13 is in the position shown in Fig. 2 due to the effect of the spring 25. However, in the case of the embodiment shown in Fig. 3, when fluid pressure is supplied to the servovalve, the spool 13 will remain against the end stop 26 because of the offset of the flapper 34 which increases the pressure supplied through the port 28 relative to the pressure supplied through the port 27. To bring the spool 13 back into the normal range it is necessary to apply an electrical bias signal to the servo-motor 33 to move the flapper 34 to a position in which the fluid pressure supplied to the port 27 balances the fluid pressure supplied to the port 28 plus the force generated by the spring 25.

Once this has been effected, operation of the servovalve is the same as with any other flapper-nozzle servovalve of this type, i.e. a small variation in the applied signal to the servo-motor 33 will produce a proportional variation in the fluid pressure output from the servovalve.

In the event of a loss of fluid pressure the spool 13 will be urged rapidly by the spring 25 to a predetermined failure position beyond the normal range of movement of the spool 13 (as shown in Fig. 2). In this failure position the feedback member 35 will become disengaged from the flange 37 and so all proportional contact is lost.

With the spool 13 in this failure position, the actuator means 22 is left in a floating condition, the supply ports 19 and 20 cooperating with the return ports 16 and 17.

Similarly, if there is a failure of the control signal supplied to the servo-motor 33 the flapper 34 will return to the position shown in Fig. 3 and the resulting increase in pressure in the control port 28 will drive spool member 13 to the left until it contacts the end stop 26. With the spool member 13 in this position the actuator means 22 is again left in a floating condition.

Irrespective of the mode of failure of the servovalve, therefore, the actuator means 22 is always rapidly restored to a safe condition.

In the embodiment shown in Fig. 4, the only significant difference of construction is that the servo-motor 33 is tilted in the opposite direction to that shown in Fig. 3, thereby bringing the flapper 34 towards the nozzle 31.

In using this serovalve, when no electrical power or fluid pressure is supplied to the servovalve the spool 13 tekes up a position abutting the end stop 26 due to the effect of the spring 25. However, when a supply of fluid pressure is connected to the servovalve, the spool 13 will move to a normal position as the offset in the flapper 34 raises the fluid pressure in the port 27 sufficiently to balance the combined effect of the spring 25 and the pressure supplied to the port 28.

Standard servovalve operation then epplies except that in the event of a fluid pressure feilure the spool 13 will be driven to the left by the spring 25 until it contacts the end stop 26, in which position the actuator means 22 is left in a floating condition and the ports 19 and 20 cooperate with the ports 16 and 17.

The ports of servovalves of the invention can in general be designed so that, in a failed mode, the actuator means is locked by trapped fluid pressure in a predetermined position. Preferably, the ports will be designed so that, even if the supply of fluid pressure should fail in such a manner as to urge the spool member against the spring, the pressure responsive actuator means will be left in a floating or locked condition.

As an alternative to the embodiments described above, the displacement of the flapper towards one or other of the nozzles may be achieved by rectilinearly displacing the servo-motor relative to the nozzles rather than tilting it. Equally, the displacement of the flapper towards one or other of the nozzles may be achieved by magnetically biassing the armature of the servo-motor.

The spool may also be moved into said failure position by means of a greater than normal electrical signal applied to the servo-motor to move the flapper in a direction to increase the fluid pressure to the right-hand side (as shown in the drawings) of the spool member.

CLAIMS

1. A servovalve comprising a body having a bore therein, at least one supply port for connecting the bore to a source of pressurised fluid, at least one output port for connecting the bore to a pressure responsive actuator means, a spool having two distal end faces and being exially movable within the bore in response to differential fluid pressure acting on the two distal end faces of the spool from the source of pressurised fluid, means to bias the spool towards one end of

the bore and electro-mechanical means to control the position of the spool within a normal range within the bore to provide a variable fluid output from the servovalve that is proportional to the electrical signal suppliad to tha electro-mechanical control means, wherein, in the evant of a failura of supply of fluid pressure from the source, the spool is urged rapidly by tha bias means to a predetermined failure position beyond the normal ranga of tha spool.

2. A servovalva according to claim 1 in which the electro-mechanical control means is a servo-motor driving a flapper for cooperation with one or other of a pair of nozzles.

3. A servovalve according to claim 1 or claim 2 in which tha bias means is a spring acting on a distal end faca of the spool.

4. A servovalve according to claim 1 or claim 2 in which the bias means is a mechanical offset of a servo-motor/flapper arrangement.

5. A servovalve according to any one of claims 2 to 4 in which the flapper has attached thereto a resilient feedback mamber to engage a flange on the spool.

6. A servovalve according to claim 1 substantially as herein described with reference to any one of Figs. 1 to 4 inclusive.

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